

Research Article

The Relationship Between Grammatical Development and Disfluencies in Preschool Children Who Stutter and Those Who Recover

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Purpose: The dual diathesis stressor model indicates that a mismatch between a child's endogenous linguistic abilities and exogenous linguistic contexts is one factor that contributes to stuttering behavior. In the present study, we used a developmental framework to investigate if reducing the gap between endogenous and exogenous linguistic factors would result in less disfluency for typical children, children who recover from stuttering (CWS-R), and children who persist.

Method: Children between 28 and 43 months of age participated in this study: 8 typical children, 5 CWS-R, and 8 children who persist. The children were followed for 18 months with language samples collected every 6 months. The Index of Productive Syntax (Scarborough,

1990) served as a measure of endogenous grammatical ability. Length and complexity of active declarative sentences served as a measure of exogenous linguistic demand. A hierarchical linear model analysis was conducted using a mixed-model approach.

Results: The results partially corroborate the dual diathesis stressor model. Disfluencies significantly decreased in CWS-R as grammatical abilities (not age) increased. Language development may serve as a protective factor or catalyst for recovery for CWS-R. As grammatical ability grew and the gap between linguistic ability and demand decreased; however, none of the three groups was more likely to produce disfluencies in longer and more complex utterances.

Stuttering is a neurodevelopmental disorder of speech that emerges from a complex interaction of multiple factors. Ample evidence in the literature reveals the domain of language is one such factor. Although the term *language* is broad, recent theories include linguistic components in either the etiology of stuttering or as contributors to the moment of disfluency itself (Conture & Walden, 2012; Howell & Au-Yeung, 2002; Postma & Kolk, 1993; Smith & Kelly, 1997; Starkweather, 1987). Regarding etiology, studies such as those by Weber-Fox, Hampton Wray, and Arnold (2013) show that children who stutter (CWS) demonstrate differences in processing semantic and syntactic information. Regarding the moment of stuttering, studies

have identified that word type, word frequency, neighborhood density, grammatical complexity, and sentence length significantly influence the probability of producing a moment or instance of disfluency (e.g., Anderson, 2007; Au-Yeung, Howell, & Pilgrim, 1998; Logan & Conture, 1995).

Of specific interest to this investigation are studies indicating that linguistic mismatches, or dissociations, are particularly salient to CWS. For example, CWS are more likely to exhibit dissociations or developmental asynchronies within language domains (e.g., mismatches between receptive and expressive language skills) and between language and speech motor domains (e.g., developmental mismatches between expressive language skills and diadochokinetic rate; Anderson, Pellowski, & Conture, 2005; Clark, Conture, Walden, & Lambert, 2015; Coulter, Anderson, & Conture, 2009; Hollister, Zebrowski, & Alpermann, 2012). In addition to underlying developmental mismatches, there are indications that disparities between a child's endogenous linguistic abilities (internal linguistic abilities) and exogenous linguistic contexts (internal or external demand for linguistic production) have also been observed to contribute to moments of stuttering (e.g., Walden et al., 2012). In summary,

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a number of lines of research have converged to support theories that varying degrees of dissociation between endogenous and exogenous linguistic factors play a central role in the probability of disfluency in children who are predisposed to stuttering.

The Dual Diathesis Stressor Model

The dual diathesis stressor (DDS) model (Conture & Walden, 2012) is a relatively recent framework proposed to explain how the interaction between endogenous abilities and exogenous contexts can influence stuttering. The DDS model extends the key premises first articulated in the demands and capacities (DC) model of stuttering (Andrews et al., 1983; Starkweather, 1987), in which both typical and stuttered speech disfluencies emerge when demands placed on a child for fluent speech production exceed the child's capacities to do so. To be specific, the DDS model proposes that CWS have endogenous abilities, termed *diatheses*, in either emotional or linguistic (expressive and receptive language) domains, or both, that interact in a dynamic way with emotional and linguistic exogenous contexts. These interactions result in either fluent or stuttered speech.

Two important distinctions between the DC and DDS models exist. First, whereas the DC model encompasses several domains in which a mismatch can exist (e.g., linguistic, motor, cognitive, and social/emotional), the DDS model focuses on two: emotional and linguistic. Second, the DDS model emphasizes that it is not the exogenous contexts themselves that are responsible for a stuttering moment but how the child copes with these through endogenous diathetic loadings—that is, a child's endogenous abilities are what moderate the relationship between his or her stuttering and exogenous contexts. An example of such an exogenous context might be a situation that requires the child to produce a complex narrative to an unfamiliar listener or person in authority. In this situation, the child would be speaking in a context that necessitates a greater than usual amount of speech or sophisticated language (such as syntactically complex utterances or an advanced vocabulary). If the child has typically developing endogenous language abilities that match the demands from exogenous contexts, fluency would be minimally affected. However, if there are underlying vulnerabilities in endogenous planning or production, stuttering is likely to be exacerbated (Conture & Walden, 2012; Walden et al., 2012).

Indeed, there is robust evidence that specific types of utterances, such as longer and more complex sentences, are more likely to be disfluent for both CWS and children who do not stutter (CWNS; Bernstein Ratner & Costa Sih, 1987; Buhr & Zebrowski, 2009; Gaines, Runyan, & Meyers, 1991; Logan & Conture, 1995; Logan & LaSalle, 1999; McLaughlin & Cullinan, 1989; Rispoli & Hadley, 2001; Watson, Byrd, & Carlo, 2011; Wijnen, 1990; Yarus, 1999). It is reasonable to speculate that, for both CWS and CWNS, increased utterance length contributes to disfluencies by taxing the process of sentence planning, whereas complexity may stress both utterance planning and production because

of the increase in the number of linguistic procedures that need to be incorporated (Bock & Levelt, 1994; Kempen & Hoenkamp, 1987; Levelt, 1993; Rispoli & Hadley, 2001). Thus, in both the DC and DDS models, the root of disfluency lies in the extent to which exogenous linguistic contexts exceed the underlying endogenous ability to fluently produce them.

To date, only one published study has examined the linguistic presupposition of the DDS model (Walden et al., 2012). In that study, Walden et al. assessed 19 CWS and 22 CWNS between the ages of 37 and 60 months. The following standardized expressive and receptive language tests were used to assess the children's endogenous linguistic abilities: (a) the Peabody Picture Vocabulary Test—III (PPVT-III; Dunn & Dunn, 1997), (b) the Expressive Vocabulary Test—Second Edition (EVT-2; Williams, 1997), and (c) the Test of Early Language Development—Third Edition (TELD-3; Hresko, Reid, & Hammill, 1999). The results revealed that the children's expressive language skills (as evidenced by test scatter) were predictive of stuttering, but their levels of language development (as measured by the discrepancy between their standard score and their age norm) were not. This latter finding was unexpected as, according to the DDS model, stuttering should decrease as the gap between a child's endogenous linguistic abilities and the exogenous linguistic demands placed on him or her narrows.

There are four intriguing possibilities for the lack of a significant relationship between language development and disfluency in the Walden et al. (2012) study. A first possibility is that the DDS model is incorrect; overall language development does not significantly affect disfluency production. A second possibility is that the static measurement methods used in the study were not able to capture a relationship between language skill and amount of disfluency—that is, the researchers measured language skills at one period in time and in relation to age but did not measure the relationship between language skills and disfluency dynamically across levels of linguistic development. A third possibility is that the measures of linguistic development used, calculated discrepancy scores between a child's standardized receptive and expressive language test scores and the published norms for his or her age, may not have been sufficiently sensitive measures of linguistic development. A final possibility is that participants were preschool CWS, some of whom, statistically speaking, would recover from stuttering and some of whom would persist. The inability to identify and separate CWS into these subgroups may have diluted or masked group differences in the relationship between language development and disfluencies. It may be the case that the decreasing gap between endogenous linguistic ability and exogenous linguistic contexts is more pertinent to a specific group of children, such as children who will recover from stuttering rather than for children who persist.

The Leading Edge Hypothesis

The DDS model is not the only framework to hypothesize that disfluencies arise from discrepancies between endogenous linguistic ability and exogenous linguistic contexts.

In their leading edge (LE) hypothesis, Rispoli, Hadley, and colleagues (Rispoli, 2003; Rispoli & Hadley, 2001; Rispoli, Hadley, & Holt, 2008) argue that a child's level of grammatical ability can determine patterns of disfluency seen in conditions of both high and low production demand. Several critical differences exist between the LE hypothesis and the DDS accounts. First, the LE hypothesis was developed specifically to explain errors and disfluencies in 2- to 3-year-old typically developing children, whereas the DDS model was designed to account for disfluencies in CWS across a broader age range. Perhaps it is more important to note that the LE hypothesis assumes that disfluencies arise when the grammatical form of the sentence the child is trying to produce is just beyond his or her current grammatical production skill level. Early in development, children presumably are equally fluent or disfluent in almost all utterances because all sentence frames, even simple ones, place a strain on their immature production skills. As longer and more complex utterances enter the child's production abilities, however, the locus of disfluency shifts to more grammatically complex utterances. In contrast to this grammar-specific framework, the DDS model indicates that disfluencies stem from a dynamic relationship between more broadly defined endogenous and exogenous linguistic factors. Thus, in the DDS model it is not assumed that disfluency patterns are primarily tied to the child's capacity to use grammatical forms. Rather, the endogenous and exogenous linguistic factors at play and their relationships can vary from moment to moment. In the LE model, the relationships between endogenous grammatical markers and exogenous grammatical contexts are characteristically more fixed. Nonetheless, the two frameworks agree in principle that the mismatch between endogenous abilities and exogenous contexts lead to a higher probability of disfluent productions.

Two previous studies have applied the idea of the LE hypothesis to CWS. Wagovich, Hall, and Clifford (2009) used the LE hypothesis to examine changes in three different disfluency patterns across the lexical development of preschool CWS. Another study by Watson et al. (2011) utilized the LE paradigm to examine if Spanish-speaking CWS were equally as likely to produce disfluencies on grammatical and ungrammatical utterances. Although both of these studies lend support to the application of the LE hypothesis to CWS, neither study utilized nor extended the core hypothesis of the LE paradigm to CWS. To be specific, the authors of neither study investigated if a child's endogenous grammatical abilities affect the relationship between exogenous linguistic contexts and disfluency and if this relationship changes across development. We believe that adopting the core grammatical framework of the LE hypothesis, along with its analytical methods, provides a unique avenue for investigating the linguistic premise of the DDS model in an ecologically valid and developmental way.

The LE hypothesis is useful in three specific ways. First, the LE framework allows for the investigation of disfluency patterns and probabilities within a developmental framework by using a child's grammatical attainment, rather

than age, as the unit of measurement. This is a significant advantage as language skills do not develop at the same rate as age. Measuring how disfluency patterns change as language skills increase, rather than as the child ages, offers a more ecologically valid picture of the relationship between language abilities and disfluencies. Second, selecting a specific aspect of linguistic acquisition, grammar, and measuring it in a detailed way allows for a more sensitive reflection of one aspect of children's endogenous linguistic abilities. The LE methodology also allows for separate analysis of both endogenous linguistic ability and disfluencies at the same time point. Third, the LE framework offers a system for operationalizing exogenous linguistic contexts through the measurement of a child's sentence length and complexity. The analysis methods also allow for dissociating utterance length from utterance complexity.

Study Purpose

This present study had two aims. The first was to investigate the linguistic premise of the DDS model in a way that accounts for development by using the analysis methods of the LE framework. To do this, we followed the methods of Rispoli and colleagues (Rispoli, 2003; Rispoli & Hadley, 2001; Rispoli et al., 2008) and used the child's utterance length and complexity as a reflection of exogenous linguistic contexts. We also used the child's level of grammatical ability, as measured by the Index of Productive Syntax (IPSYN; Scarborough, 1990), as a proxy for the child's endogenous linguistic abilities. By following the children longitudinally over the course of grammatical development rather than age, we were able to investigate the relationship between endogenous linguistic abilities, disfluency production, and exogenous linguistic contexts in a dynamic rather than a static way. We hypothesized that we would observe three things in accordance with the DDS model. First, as grammatical development progressed (and endogenous linguistic abilities strengthened), overall rate of disfluency would decrease. Second, utterances that had increased length and complexity (the result of more demanding exogenous linguistic contexts) would contain more disfluencies. Third, as grammatical development progressed, shorter and less complex sentences would contain fewer disfluencies, whereas longer and more complex utterances would have disproportionately more disfluencies.

The second aim was to compare the relationship between endogenous linguistic abilities and exogenous demands in three groups of preschool-aged children: CWNS, children who would later recover from stuttering (CWS-R), and children who would persist in stuttering (CWS-P). Although at present there is little evidence of developmental differences in syntactic or semantic language skills of CWS-R and CWS-P (Yairi & Ambrose, 1999), Yairi and colleagues have noted a clinical trend; CWS-R appear to decelerate their linguistic expansion right before they recover (Watkins et al., 2000; Yairi & Ambrose, 2005, p. 246). Some children may be more susceptible to breakdown due to a mismatch between their endogenous linguistic abilities and

exogenous linguistic contexts, as is proposed by the DDS model, and this may be particularly pertinent to recovery. We hypothesized that although this trend is apparent across the three groups, CWS-R would show a greater benefit from resolving linguistic discrepancies between endogenous abilities and exogenous contexts than CWS-P or CWNS.

There were two specific research questions guiding our study:

1. As grammatical development progresses and a child's endogenous linguistic abilities strengthen, are CWNS, CWS-R, and CWS-P all less likely to produce disfluencies?
2. Is there a relationship between the length and complexity of sentences and the likelihood of disfluency production, and does this relationship change across grammatical development?

Method

Participants

The participants were 21 children between the ages of 28 and 43 months ($M = 35.1$, $SD = 5.3$) at the time of their initial visit. Thirteen of these children were considered to be CWS. Five of them would later recover ($M = 35.2$, $SD = 5.8$), and eight would persist in stuttering ($M = 37.1$, $SD = 4.6$). The remaining eight participants did not stutter ($M = 33.1$, $SD = 5.6$). It is critical to note that group membership was determined during Visit 4, a visit not used in our analyses. The criteria for determining group membership are described below. All children were standard American English speakers, had normal neurological histories, and did not take any medications that would affect neural function (Yairi & Ambrose, 1999). All CWS had been stuttering for at least 4 months before the initial intake visit. Participants were selected from a larger group of 37 children who had taken part in a previous study in collaboration with the University of Illinois (Subtypes and Associated Risk Factors in Stuttering R01#DC05210). Participants were excluded from this study if they were older than 43 months at the time of their initial visit ($n = 15$) or if their language sample consisted of fewer than 100 utterances at more than one of the three clinic visits ($n = 1$).

Procedures

Participants were seen four times in an 18-month period. In addition to the initial intake visit (Visit 1), three postintake visits took place. These were at 6 months (Visit 2), 12 months (Visit 3), and 18 months (Visit 4). To ensure children did not fall below the mean in receptive and expressive language skills, each participant was administered standardized receptive and expressive language tests at Visits 1 and 3. These included the EVT-2, the PPVT-III, and the TELD-3. At Visit 1, 19 participants fell within or above 1 SD of the mean (16th percentile) on all tests administered. Two participants (one CWNS, one CWS-R)

fell below 1 SD of the mean on one of the three tests. In both cases, the child's overall language test profile was within the 1 SD criteria, and results from the single test were considered unrepresentative. All participants fell at or above 1 SD of the mean on all language assessment measures at clinic Visit 3. Table 1 displays the range of scores, means, and standard deviations for each participant group.

At each visit, the children were invited to engage in a 15- to 30-min unstructured Play-Doh activity with their primary caregiver. These play sessions were audio-recorded and transcribed for coding. Language samples from Visits 1, 2, and 3 were coded and used for our analyses. The language sample from Visit 4 was used to determine group membership. Research assistants transcribed the audio-recorded language samples and coded them for utterance breaks, use of morphology, and presence of disfluencies according to the procedures given by the Systematic Analysis of Language Transcripts (Miller & Chapman, 2000), Rispoli and Hadley (2001), and Rispoli et al. (2008). To be specific, utterances could be complete or incomplete sentences, and compound sentences were limited to a maximum of two clauses. To ensure utterances were spontaneous, answers to forced choice, yes/no, or constraining questions that only required the child to use a simple noun phrase were eliminated. Unintelligible, imitative, and self-repetitive utterances and isolated filler words (e.g., *um*, *OK*) were also eliminated from analysis (Miller & Iglesias, 2010; Scarborough, 1990). This resulted in the elimination of 5,013 of the 16,915 total utterances produced and corresponded to between 13.1% and 57.9% of each child's total utterance production ($M = 30.07$, $SD = 9.9$). The first author later listened to all of the language samples, reviewed the transcripts, corrected morphology and utterance breaks as needed, and coded for disfluencies.

Language Coding

Grammatical development was calculated using the IPSYN, which assesses mastery of 56 different morphological and syntactic structures. A 100-utterance sample was randomly selected from each child to determine his or her IPSYN score and mean length of utterance (MLU) per Scarborough's (1990) scoring criteria.

Active declarative sentences (ADSs) were then identified from the entire language sample and classified according to length and complexity, following the procedures suggested by Rispoli and colleagues (Rispoli, 2003; Rispoli & Hadley, 2001; Rispoli et al., 2008). Using ADSs constrained the utterances to statements (i.e., not questions or imperatives), which simplified the underlying linguistic structures and made utterance complexity more transparent. For instance, we did not have to attempt to determine if a question formed from a Level 2 sentence (see the next section and Table 2) was equivalent to a Level 1 sentence (because it was missing a noun phrase) or a Level 3 sentence because it involved movement and traces. All ADS utterances were assigned a complexity level, the length in words was documented, and the presence or absence of a disfluency coded.

Table 1. Standardized language test scores by group at Visits 1 and 3.

Group	Visit 1					Visit 3 (12 months)			
	Age (months)	PPVT-III	EVT-2	TELD-3 (R)	TELD-3 (E)	PPVT-III	EVT-2	TELD-3 (R)	TELD-3 (E)
CWNS (<i>n</i> = 8)									
<i>M</i>	34.2	100.3	114.60	123	109.1	117.5	122.1	122.3	111.6
<i>SD</i>	6.2	11.6	13.67	19	15.9	16.6	13.6	14.3	13.7
Min–max	28–43	77–112	92–135	89–150	86–127	95–146	101–144	102–140	94–127
CWS-R (<i>n</i> = 5)									
<i>M</i>	35.3	111.40	126.4	121.4	116.2	115.0	117.4	128.8	112.0
<i>SD</i>	5.2	11.28	18.4	20.0	14.2	7.9	4.0	15.7	5.8
Min–max	30–42	98–129	102–147	89–137	94–131	106–123	113–123	108–143	106–120
CWS-P (<i>n</i> = 8)									
<i>M</i>	36.3	107.63	104.63	110	102.0	110.5	114.8	110.4	105.8
<i>SD</i>	4.7	11.10	10.70	20	20.7	7.7	13.4	18.5	12.8
Min–max	31–42	92–123	85–117	86–128	65–124	98–124	96–137	91–140	88–121
Between-group differences	<i>p</i> = .34	<i>p</i> = .24	<i>p</i> = .04	<i>p</i> = .37	<i>p</i> = .40	<i>p</i> = .54	<i>p</i> = .50	<i>p</i> = .14	<i>p</i> = .55

Note. All group comparisons using a one-way analysis of variance were nonsignificant. PPVT-III = Peabody Picture Vocabulary Test–III; EVT-2 = Expressive Vocabulary Test–Second Edition; TELD-3 (R) = Test of Early Language Development–Third Edition (Receptive Language subtest); TELD-3 (E) = Test of Early Language Development–Third Edition (Expressive Language subtest); CWNS = children who do not stutter; CWS-R = children who recover from stuttering; CWS-P = children who persist in stuttering. *p* < .002 (Bonferroni correction of α = .05).

Complexity Coding

We assigned each ADS to a complexity level on the basis of the complexity of the verb phrase. In accordance with the criteria established by Rispoli and Hadley (2001), the complexity of a verb phrase was determined by the noun phrase that followed the verb (see Table 2).

Disfluency Coding

Each ADS was coded for the presence or absence of a disfluency. This binary coding method was chosen for three reasons: (a) It maintained consistency with the methods of the LE hypothesis; (b) it allowed us to retain statistical power; and (c) analyses conducted using binary disfluency coding captures the relationship between disfluency production, length, and complexity just as well as methods that use the percentage of disfluent syllables (Bernstein Ratner & Costa Sih, 1987). Speech disfluencies were considered any of the speech errors described by Rispoli and colleagues

(Rispoli, 2003; Rispoli & Hadley, 2001; Rispoli et al., 2008) as well as any remaining stuttering-like disfluencies (SLDs; Conture & Kelly, 1991). As described by Rispoli et al. (2008), disfluencies included (a) lexical, phonological, or content revisions; (b) part word, whole monosyllabic word, multisyllabic word, and phrase repetitions; (c) silent pauses that were between 0.6 and 3 s; and (d) fillers such as *um* and *uh* if they were embedded in the sentence. Silent pauses and fillers were not counted as disfluencies if they occurred at the beginning of a sentence or if a child changed his or her response from an anaphoric yes to no or vice versa. Two additional SLDs, audible and inaudible prolongations (Conture & Kelly, 1991), were also included along with those classified by Rispoli and colleagues.

Criteria for Classifying CWS-R and CWS-P

Participants were initially classified as stuttering if they met three conditions at Visit 1: (a) the child's parents

Table 2. Active declarative sentence complexity levels following the criteria of Rispoli and Hadley (2001).

Level	Description	Example
Level 1	A simple verb phrase complement only (no additional clauses, noun phrases, or present participles with noun phrase objects).	<i>He ate.</i>
Level 2	An expanded noun phrase and [prepositional phrase (noun phrase)] complement. The complement does not contain a finite/nonfinite clause.	<i>She ate a sandwich.</i> <i>She ran to the store.</i>
Level 3	Nonfinite complements with the same subject as the matrix clause.	<i>He wanted to eat ice cream.</i>
Level 4	Finite and nonfinite complements that have a different subject than that of the matrix clause.	<i>His mom wanted him to clean his room.</i> <i>She thought he was happy.</i>

or two clinicians involved in the study agreed that the child was exhibiting stuttering behavior, (b) the onset of stuttering behavior was at least 4 months prior to the initial visit, and (c) the child exhibited at least three SLDs per 100 words of spontaneous speech (Pellowski & Conture, 2002). At each visit, participants were reevaluated for stuttering. To determine recovery or persistence, general criteria described by Yairi and Ambrose (1999) were used. A child was considered to have recovered only if he or she met all of the following conditions: (a) The child's parents and the clinician considered the child to no longer be stuttering; (b) the child exhibited less than three SLDs per 100 words of spontaneous speech; and (c) the child scored less than 1 on an 8-point severity scale as rated by both the parents and the clinician, on which 0 was *normal* and 7 was *very severe*. Stuttering was considered to have persisted if the child met either of the following criteria: (a) The parents or the clinician regarded the child to be stuttering and (b) either the clinician or parents rated the stuttering as greater than 1 on the 8-point severity scale. All CWS-R and CWS-P continued to meet the criteria for stuttering during all three visits to the clinic. Final determinations of persisted and recovered categories were based on data from the child's fourth visit, which occurred 18 months after the child's initial visit and at least 22 months after the child started stuttering. This ensured that the group assignment made on the fourth visit was independent of the language sample analyses conducted. One of the 13 CWS did not formally attend the fourth clinic visit; however, his mother confirmed that he was still stuttering at that time. Thus, this child continued to meet the criteria of Yairi and Ambrose (1999) for persistent stuttering. Descriptive data regarding the participants' stuttering characteristics are displayed in Table 3.

The majority of the children did not possess a history of speech, language, or fluency intervention, nor did this

change during the duration of the study. Two children (one CWS-R and one CWS-P) were receiving fluency therapy, and two CWS-P were receiving articulation and fluency therapy. These therapy profiles are consistent with previous findings in the literature, indicating that CWS who have co-occurring or phonological difficulties have a greater likelihood of persistent stuttering (Paden & Yairi, 1996). Overall, the therapy histories of the two groups are not considered to unduly influence the empirical questions of this study.

Reliability

Four independent inter-rater reliability assessments were completed: (a) agreement in morpheme-by-morpheme transcriptions and utterance breaks, (b) agreement in the calculation of grammatical competency as measured by the IPSYN, (c) agreement in the classification of disfluent or fluent ADSs, and (d) agreement in the classification of utterance complexity. The data from each of five randomly selected participants for all three visits (24% of the sample; two CWNS, one CWS-R, and two CWS-P) were used to assess the reliability of the first three measures. This resulted in a total of 15 language samples selected for reliability testing. A random sample of 20% of all utterances produced (385 utterances) was selected to assess the reliability of the fourth measure, utterance complexity. The first author and a doctoral student served as the inter-rater reliability judges for the first three measures. The first and second authors assessed the reliability of the fourth measure.

An acceptable criterion for the item-by-item agreement across each of the 15 language samples was set at 90% (Rispoli et al., 2008). Following Rispoli, Hadley, and Holt (2008), differences in unstressed morphemes (*a/the*) were not counted as a discrepancy. The 15 transcripts all fell within the acceptable range, with morpheme-by-morpheme

Table 3. Description of stuttering characteristics of CWS-R and CWS-P at Visits 1 and 4.

Participant	Visit 1			Visit 4 (18 months)		
	% SLD	Severity score	Considered stuttering by parents	% SLD	Severity score	Considered stuttering by parents
CWS-R-1	15%–20%	2.70	yes	<3%	0.0	no
CWS-R-2	3%	1.90	yes	<3%	0.0	no
CWS-R-3	3%	1.60	yes	<3%	0.0	no
CWS-R-4	>20%	2.60	yes	<3%	0.0	no
CWS-R-5	3%	1.00	yes	<3%	0.0	no
CWS-P-1	15%–20%	2.25	yes	<3%	0.0	yes
CWS-P-2	>20%	4.50	yes	10%–15%	3.3	yes
CWS-P-3	15%–20%	2.70	yes	<3%	1.0	yes
CWS-P-4	>20%	4.80	yes	3%–5%	1.3	yes
CWS-P-5	3%–5%	0.30	yes	7%–10%	2.0	yes
CWS-P-6	7%–10%	2.00	yes	<3%	1.0	yes
CWS-P-7	3%–5%	0.60	yes	3%–5%	1.3	yes
CWS-P-8	10%–15%	4.20	yes	n/a	n/a	yes

Note. Between-group comparisons of stuttering severity at Visit 1 using a one-way analysis of variance were nonsignificant ($p = .40$); CWS-R ($M = 2.0$, $SD = 0.71$), CWS-P ($M = 2.7$, $SD = 1.7$). CWS-R = children who recover from stuttering; CWS-P = children who persist in stuttering; SLD = stuttering-like disfluency.

agreements ranging from 93% to 99% ($M = 96.1$, $SD = 2.1$) and utterance break agreements ranging from 92% to 99% ($M = 96.3$, $SD = 2.0$). Discrepancies, when they arose, were predominantly due to differences in the morphemes perceived or differences in what was deemed unintelligible.

Final total IPSYN scores (which ranged from 49 to 97) were considered in agreement if they fell within three points of each other. All of the 15 samples met this criterion for agreement. For the third measure, agreement in the fluency classifications of ADSs, a Cohen's kappa was used (Rispoli, 2003; Rispoli et al., 2008). This analysis was conducted using two levels: fluent and disfluent. Because moments of disfluency were relatively infrequent, utterances from the three clinic visits were collapsed for this analysis as in other studies (Rispoli et al., 2008; Wagovich et al., 2009). The k ranged from .85 to .90 ($M = .88$, $SD = .04$), indicating strong agreement (Sprent & Smeeton, 2001).

An acceptable criterion for utterance complexity coding was set at 90%. The agreement in complexity ratings of the 385 random utterances selected fell within this acceptable range at 95.1%.

Results

A total of 3,854 intelligible and spontaneous ADSs were produced by the 21 participants. Of these, 2,742 were fluent and 1,112 disfluent. Table 4 displays descriptive information about the language samples for each subject group.

As our study aimed to investigate disfluency patterns across language development, we first wanted to examine all standardized test measures and language samples for between-group differences. Toward this aim, a series of 27 one-way analyses of variance were conducted to investigate group differences in standardized language tests and language sample measures (see Tables 2 and 4). Bonferroni corrections were applied due to the number of comparisons, which adjusted the α level from .050 to .002. No significant between-group differences were found across the three visits for any measure. The p values were generally large ($p > .5$), reflecting a high degree of overlap (Frick, 1995).

In preparation for the regression models described later, correlation analyses were conducted between the IPSYN, standardized language measures, and disfluency production at Visits 1 and 3 (see Tables 5 and 6). All correlations demonstrated expected trends. At Visit 1, IPSYN positively correlated with both MLU ($r = .76$, $p \leq .01$) and the PPVT-III ($r = .49$, $p \leq .05$). The PPVT-III positively correlated with MLU ($r = .48$, $p \leq .05$) and the EVT-2 ($r = .51$, $p \leq .05$), and the EVT-2 positively correlated with the TELD-3 (E; $r = .60$, $p \leq .05$). At Visit 3, IPSYN positively correlated with MLU ($r = .69$, $p \leq .01$), and the TELD-3 Receptive Language subtest (R) positively correlated with the TELD-3 Expressive Language subtest (E; $r = .56$, $p \leq .01$) and the EVT-2 ($r = .58$, $p \leq .01$). Overall rate of disfluency was positively correlated with SLD production at both Visits 1 ($r = .56$, $p \leq .05$) and 3 ($r = .76$, $p \leq .01$).

Table 4. Description of language sample measures across subjects.

Measures	CWNS			CWS-R			CWS-P			Between-group differences
	<i>M</i>	<i>SD</i>	Min–Max	<i>M</i>	<i>SD</i>	Min–Max	<i>M</i>	<i>SD</i>	Min–Max	
Visit 1										
IPSYN	76.7	13.1	56–94	72.8	11.3	54–83	66.5	14.5	47–83	$p = .32$
MLU	4.0	0.5	2.9–4.7	4.4	1.3	2.4–5.8	3.6	0.6	2.9–4.7	$p = .30$
Total ADSs	59.0	20.4	41–103	57.0	31.7	23–99	53.9	27.5	22–110	$p = .93$
Disfluent ADSs	12.0	10.0	2–30	23.2	12.8	13–52	18.9	13.8	9–18	$p = .27$
Average complexity	2.4	0.8	2–2.6	2.2	0.6	1.8–2.5	2.2	0.7	2–2.5	$p = .30$
Average length	5.2	2.0	3.6–6.1	5.1	1.9	3.6–6.9	4.4	1.4	4.1–5.3	$p = .29$
Visit 2 (6 months)										
IPSYN	81.3	8.2	71–94	79.4	6.4	69–85	80.1	7.5	65–88	$p = .91$
MLU	4.7	0.5	3.2–5.4	4.4	0.5	3.8–4.9	4.3	0.5	3.4–4.7	$p = .46$
Total ADSs	67.5	30.8	37–135	34.6	11.1	24–51	34.8	15.4	13–60	$p = .01$
Disfluent ADSs	16.8	13.8	4–51	15.4	4.6	9–22	11.8	6.2	3–21	$p = .61$
Average complexity	2.3	0.7	2.1–2.6	2.3	0.8	1.8–2.3	2.2	0.7	2.1–2.5	$p = .45$
Average length	5.4	2.0	4.3–6.5	5.7	2.0	4.5–5.5	4.9	1.5	4.7–6.5	$p = .20$
Visit 3 (12 months)										
IPSYN	86.4	6.6	73–95	84.8	3.4	72–90	83.6	15.6	65–99	$p = .82$
MLU	4.7	0.9	3.5–6	4.7	0.9	3.4–5.9	4.6	0.6	3.7–5.5	$p = .93$
Total ADSs	74.5	35.5	32–129	102.4	41.3	34–144	70.8	22.5	42–103	$p = .23$
Disfluent ADSs	12.6	8.0	2–28	27.8	13.7	14–49	25.5	11.7	10–47	$p = .04$
Average complexity	2.3	0.7	2.1–2.7	2.3	0.9	1.9–2.4	2.4	0.6	2.1–2.6	$p = .46$
Average length	5.4	0.7	4.2–6.1	5.7	0.8	4.5–6.6	5.5	0.6	4.6–6.0	$p = .72$

Note. All group comparisons using a one-way analysis of variance were nonsignificant. CWNS = children who do not stutter; CWS-R = children who recover from stuttering; CWS-P = children who persist in stuttering; IPSYN = Index of Productive Syntax; MLU = mean length of utterances; ADS = active declarative sentence. $p < .002$ (Bonferroni correction of $\alpha = .05$).

Table 5. Correlation analysis of Visit 1.

	IPSYN	MLU	EVT-2	PPVT-III	TELD-3 (E)	TELD-3 (R)	Disfluency production	SLD production	TD production
IPSYN	—	.76**	.29	.49*	.35	.22	-.23	-.34	.30
MLU		—	.19	.48*	.24	-.05	-.13	-.19	.17
EVT-2			—	.51*	.60**	.08	.16	.17	-.02
PPVT-III				—	.34	.06	.18	.17	.02
TELD-3 (E)					—	.16	-.27	-.28	.05
TELD-3 (R)						—	-.14	-.08	-.17
Disfluency production							—	.56*	.04
SLD production								—	.20
TD production									—

Note. IPSYN = Index of Productive Syntax; MLU = mean length of utterances; EVT-2 = Expressive Vocabulary Test–Second Edition; PPVT-III = Peabody Picture Vocabulary Test–III; TELD-3 (E) = Test of Early Language Development–Third Edition (Expressive Language subtest); TELD-3 (R) = Test of Early Language Development–Third Edition (Receptive Language subtest); SLD = stuttering-like disfluency; TD = typical disfluencies.

* $p < .05$. ** $p < .001$.

A mixed-model logistical regression analysis was selected to investigate our two study questions. As is common with studies that focus on low incidence populations, our sample size was relatively small. Due to this limitation, we chose a statistical method that would accommodate reduced sample size. Our multivariate regression model allowed for nonindependence among repeated observation and for inclusion of all ADSs produced, eliminating the need for each child to produce a certain prerequisite number. The regression model adjusted for this by treating visits during which a child produced fewer ADSs as less reliable (Baayen, Davidson, & Bates, 2008). Our power was set at .80 and our α at .05, following Fitzmaurice, Laird, and Ware (2004), and the size of our sample groups were deemed within the appropriate range. In our model, the dependent variable was the presence or absence of a disfluency, and the predictor variables were sentence length, sentence complexity, IPSYN score, age, and diagnostic group. Subject and visit were random effects, meaning that correlations of results from within a single subject and within a single visit were corrected for mathematically. Values for α were set at .05.

Although ADSs within the data set ranged from two to 18 words in length, only sentences that were between four and six words were included in the model, resulting in a total of 2,286 ADS utterances (1,652 fluent and 634 disfluent). Following Rispoli and Hadley (2001), we wanted to dissociate utterance length from complexity. As can be seen in Table 7, utterances of less than four words were almost exclusively classified as Levels 1 and 2. In a similar manner, utterances of more than six words were much more likely to be classified as Levels 3 and 4. By only including utterances between four and six words in length, all four levels of complexity could be represented without significant gaps. This also made it easier to attribute group differences to the relevant variables rather than to sampling discrepancies. Although all subjects produced ADSs that contained six words or more, sentences of more than six words were disproportionately distributed toward CWNS, as has been reported elsewhere (Weiss & Zebrowski, 1994).

Because the variables of interest were on different scales, we standardized all values by converting them into z scores. This was done in order to compare the beta

Table 6. Correlation analysis of Visit 3.

	IPSYN	MLU	EVT-2	PPVT-III	TELD-3 (E)	TELD 3 (R)	Disfluency production	SLD production	TD production
IPSYN	—	.69**	.05	.24	.16	.03	.10	-.01	.26
MLU		—	.34	.35	.19	.07	-.02	-.16	.38
EVT-2			—	.33	.38	.58**	-.30	-.22	-.13
PPVT-III				—	.20	.39	-.10	-.13	.20
TELD-3 (E)					—	.56**	-.27	-.16	-.19
TELD-3 (R)						—	-.29	-.20	-.20
Disfluency production							—	.76**	-.07
SLD production								—	-.44*
TD production									—

Note. IPSYN = Index of Productive Syntax; MLU = mean length of utterances; EVT-2 = Expressive Vocabulary Test–Second Edition; PPVT-III = Peabody Picture Vocabulary Test–III; TELD-3 (E) = Test of Early Language Development–Third Edition (Expressive Language subtest); TELD-3 (R) = Test of Early Language Development–Third Edition (Receptive Language subtest); SLD = stuttering-like disfluency; TD = typical disfluencies.

* $p < .05$. ** $p < .001$.

Table 7. Number of active declarative sentences at each complexity level and utterance length in words.

Group	Complexity level	Length in words											
		2	3	4	5	6	7	8	9	10	11	12	13+
CWNS	1	54	53	38	10	3	0	0	0	0	0	0	0
	2		177	242	205	130	71	27	7	5	3	1	0
	3		4	57	121	90	80	39	30	12	3	0	1
	4			4	14	19	27	26	18	15	8	6	8
CWS-R	1	27	48	33	7	4	1	0	0	0	0	0	0
	2	1	68	127	135	108	50	38	15	5	5	2	0
	3		2	15	51	57	43	30	16	11	8	1	1
	4			1	4	9	7	6	7	11	9	2	5
CWS-P	1	47	54	30	13	0	0	0	0	0	0	0	0
	2		141	207	157	83	54	19	6	3	0	0	0
	3		8	79	116	99	55	25	12	10	1	2	1
	4				7	11	12	5	6	5	3	1	4

Note. Only utterances between four and six words in length were included in the data analysis (utterances in bold). Utterances of fewer than four words were almost exclusively classified as Complexity Levels 1 and 2, and utterances of more than six words were more likely to be classified as Complexity Levels 3 and 4. By only including utterances containing four to six words, we maintained consistency with Rispoli and Hadley (2001) and ensured that the data were not skewed. CWNS = children who do not stutter; CWS-R = children who recover from stuttering; CWS-P = children who persist in stuttering.

coefficients to each other in a meaningful way. The mixed-model logistical regression was then generated using the SAS GenMod procedure (SAS 9.3, SAS Institute Inc.). The regression results are presented in Table 8 with CWNS serving as the reference variable. All main effects were entered, followed by two-way and subsequent three-way interactions, but interactions were later discarded if not significant.

Age was added to the regression model as a fixed factor, but it was not a significant predictor of the likelihood of disfluency ($p = .824$). Thus, it was determined that visit ($p = .256$) captured all the variance in the model associated with development over time. As expected, group differences existed in the likelihood of producing a disfluency, $\chi^2(2) = 18.67, p < .001$. Both CWS-R ($p \leq .001$) and CWS-P ($p < .0001$) were more likely to be disfluent than CWNS; CWS-P had higher odds of being disfluent ($b = 0.94, OR = 2.31$) than CWS-R ($b = 0.78, OR = 1.88$).

IPSYN as a main effect was not a significant predictor of disfluency ($p = .496$) but was retained because the interaction between IPSYN and CWS-R was significant

($b = -0.72, p = .001$). For CWS-R, a one-point increase in IPSYN score was associated with a decrease of 0.72 in the odds of producing a disfluency, indicating that CWS-R with stronger underlying grammatical skills were less likely to be disfluent.

Sentence length was a significant predictor of the likelihood of disfluency, $\chi^2(1) = 12.89, p < .001$, indicating that as utterance length increased so did the probability of producing a disfluency. However, there was no significant interaction between the length of an utterance and diagnostic group ($p = .433$), indicating that this relationship was not distinct to one particular group of children. Sentence length also did not interact with IPSYN, suggesting that this relationship did not change with grammatical maturation ($p = .37$).

ADS complexity was not significant ($p = .089$). When tested with all other effects in the model, there was no significant interaction between ADS complexity and group ($p = .911$) or between ADS complexity and IPSYN ($p = .62$).

Table 8. Multivariate analysis using logistical regression of the predictors of disfluency (both stuttering-like disfluencies and typical disfluencies), standardized data.

Parameter		Estimate	Standard error	z	Pr > z
Intercept		-1.4026	0.1232	-11.38	<.001*
Age		-0.0228	0.1022	-0.22	.824
Group	CWS-P	0.9380	0.1642	5.71	<.001*
	CWS-R	0.7787	0.2038	3.82	<.001*
IPSYN		0.0991	0.1455	0.68	.496
IPSYN × Group	CWS-P	-0.1654	0.1522	-1.09	.277
	CWS-R	-0.7183	0.2143	-3.35	.001*
Length in words		0.5623	0.1393	4.04	<.001*
ADS complexity		-0.1023	0.0596	-1.72	.086

Note. CWS-P = children who persist in stuttering; CWS-R = children who recover from stuttering; IPSYN = Index of Productive Syntax; ADS = active declarative sentence.

* $p < .05$.

Recall that the original analysis treated all disfluencies as similar and only contrasted fluent and nonfluent utterances. Because the DDS model classifies sentences as disfluent only if they meet Conture and Kelly's (1991) criteria for SLDs, we also ran the same mixed-model logistical regression contrasting SLDs with typical disfluencies. This resulted in a total of 2,286 ADS utterances (1,936 fluent and 350 stuttering-like). The results of this analysis closely mirrored the findings of our main model (see Table 9).

Discussion

In the present study, we examined an underlying assumption of the DDS model (Conture & Walden, 2012), that a child's endogenous linguistic ability moderates the relationship between exogenous linguistic contexts and the likelihood of disfluency. To investigate this premise, we followed three groups of preschool children, CWNS, CWS-R, and CWS-P, over 18 months and assessed their patterns of disfluency production across grammatical acquisition. We used the analytical methods of the LE hypothesis proposed by Rispoli and colleagues (Rispoli, 2003; Rispoli & Hadley, 2001; Rispoli et al., 2008) and operationalized endogenous linguistic ability as grammatical development (IPSYN) and demand from endogenous contexts as the production of long and complex utterances.

Grammatical Development and Disfluency

The most intriguing finding of this study was that although all three groups of children showed comparable IPSYN scores, MLU, and language skills, a significant relationship existed between grammatical competency and disfluency production for CWS-R. To be specific, for CWS-R, an increase in IPSYN score was associated with a significant decrease in number of disfluencies produced—that is, as these children developed greater mastery of grammar and syntax, they were less likely to produce a disfluency, and this effect was independent of age. No significant relationship existed between grammatical development and disfluency production for either CWNS or CWS-P.

One might wonder if the stuttering profiles of CWS-R and CWS-P significantly influenced or mediated recovery. As can be seen in Table 3, CWS-P ($M = 2.7$, $SD = 1.7$) had both a broader range of stuttering severity and a slightly higher mean than CWS-R ($M = 2.0$, $SD = 0.71$); however, a one-way analysis of variance did not show any significant differences in stuttering severity between the two groups ($p = .40$). It is important to note that previous research has established that a child's initial stuttering severity rating does not predict the likelihood of persistence or recovery (Yairi & Ambrose, 2005, p. 78). Children who stutter severely may recover in a matter of months, whereas those who only stutter mildly may persist. Indeed, this trend can be seen in our data. The two children with the least severe stuttering level initially continued to persist in stuttering 18 months later, whereas two children who initially had a high stuttering level had recovered.

The DDS model proposes that if there is a mismatch between a child's endogenous linguistic abilities and the demands from exogenous linguistic contexts, maximal loading will occur, resulting in a high probability that the child will produce a disfluency. If the child has a minimal mismatch between endogenous ability and exogenous contexts, however, the probability of producing a disfluency will be low. Indeed, as the DDS model predicted, it was specifically the strengthening of endogenous grammatical abilities in CWS-R, not the passing of time, that corresponded to a decline in disfluency production. These results with CWS-R uphold the hypothesis of the DDS model that strengthening the underlying endogenous linguistic diathesis boosts a child's ability to prevent disfluency. It may be that for CWS-R, grammatical maturation functions as a protective factor, mitigating the risk of producing disfluencies by narrowing the gap between endogenous abilities and production demands from exogenous contexts. It is possible that closing the gap between endogenous and exogenous factors, as illustrated by the DDS model, is important for recovery. As the development of grammar progresses, these maturing grammatical skills protect the child's speech-language system, eliminating linguistic dissociation and supporting recovery.

Table 9. Multivariate analysis using logistical regression of the predictors of stuttering-like disfluencies, standardized data.

Parameter		Estimate	Standard error	z	Pr > z
Intercept		-2.658	0.1781	-14.92	<.001*
Age		-0.064	0.1703	-0.38	.707
Group	CWS-P	1.442	0.226	6.38	<.001*
	CWS-R	1.338	0.2038	4.91	<.001*
IPSYN		0.048	0.2413	-1.20	.843
IPSYN × Group	CWS-P	-0.176	0.2498	-0.71	.480
	CWS-R	-0.709	0.2573	-2.75	.006*
Length in words		0.2175	0.1393	4.04	<.001*
ADS complexity		-0.156	0.080	1.95	.051

Note. CWS-P = children who persist in stuttering; CWS-R = children who recover from stuttering; IPSYN = Index of Productive Syntax; ADS = active declarative sentence.

* $p < .05$.

Utterance Length and Disfluency

Consistent with the DDS framework, we also hypothesized that, in general, longer utterances (reflecting exogenous contexts with increased linguistic demand) would contain a higher proportion of disfluencies. We also hypothesized that as the child's endogenous grammatical abilities (IPSYN) increased (while controlling for age and visit), the gap between endogenous linguistic abilities and exogenous linguistic contexts would decrease. This would result in short utterances becoming progressively more fluent with development and disfluencies only remaining on longer utterances.

Indeed, our results showed that longer sentences were more likely to contain a disfluency than shorter ones. This was true for all subject groups across all levels of IPSYN. This finding supports the presupposition of the DDS model that endogenous contexts resulting in longer utterances have an increased likelihood of containing a disfluency. The relationship between long utterances and a higher chance of disfluencies held true across all three participant groups. These findings not only corroborate previous reports of this relationship in the literature (e.g., Bernstein Ratner & Costa Sih, 1987; Buhr & Zebrowski, 2009; Gaines et al., 1991; Logan & Conture, 1995; Logan & Conture, 1997; Logan & LaSalle, 1999; McLaughlin & Cullinan, 1989; Rispoli & Hadley, 2001; Watson et al., 2011; Wijnen, 1990; Yaruss, 1999) but also add to the literature in two interesting ways. First, these results show that the relationship between increasing length and increasing disfluency is not only present across time and age but also when measured across grammatical development. Second, this relationship is true not only in typical and stuttering children in general but for both subgroups of preschool children who stutter, those who will recover and those who will persist.

As stated above, we had also hypothesized that shorter utterances would become more fluent as IPSYN increased and the gap between endogenous ability and exogenous contexts decreased. This hypothesis was not corroborated. As observed in the regression model, the interaction between IPSYN and length ($p = .37$) was not significant. This indicated that for these children, the likelihood of producing a disfluency on a particular utterance length did not change across grammatical development.

Utterance Complexity and Disfluency

According to the DDS model, exogenous contexts with a higher demand for complexity would be more likely to contain disfluencies. The extent of this relationship, however, would depend on the strength of a child's endogenous linguistic abilities. We had hypothesized that, in general, more complex utterances would have a higher likelihood of being disfluent. Our results showed that for all participant groups, more complex utterances were no more likely to be disfluent than less complex utterances ($p = .086$). This nonsignificant finding does not corroborate previous findings in the literature in which increased complexity is related to an increased

likelihood of disfluency (Bernstein Ratner & Costa Sih, 1987; Watson et al., 2011).

Although this finding was contrary to our hypothesis, the DDS model offers a framework that may explain these results. Recall that the DDS model purports that if there is a mismatch between endogenous linguistic ability and exogenous linguistic contexts, the likelihood of breakdown is increased. It may be, however, that the production of a more complex utterance itself signals a decreasing gap between underlying ability and demand. If a child is able to demonstrate more complex utterances, it may be because he or she has developed skills that allow for that complexity. Thus, if the child is capable of independently generating complex utterances, the gap between internal ability and external demand may naturally be small, thus making the child no more likely to produce a disfluency.

To further clarify the relationship between utterance complexity and disfluency, future studies may consider using additional indicators of grammatical competency. This may include considering the presence of linguistic errors in the utterance as a measure of grammatical maturity (e.g., Watson et al., 2011) or measuring the relationship between error production and disfluency across utterance complexity. This would allow for the analysis of relationships between not just complexity and disfluency but the child's mastery of that complexity and how that influences disfluency.

Our hypothesis that complex utterances would become more fluent as IPSYN increased and the gap between endogenous linguistic ability and exogenous linguistic demand decreased, was not substantiated. The interaction between IPSYN and complexity ($p = .62$) was not significant, indicating that for these children, the likelihood of producing a disfluency on a particular utterance complexity level did not change across grammatical development.

Lack of interaction between IPSYN and both length and complexity was surprising but mirrored in part the findings of Walden et al. (2012). As previously mentioned, researchers in that study found that the gap between a child's endogenous language abilities and the corresponding expected age norms did not predict stuttering frequency. When they measured the participants' intersubtest scatter in expressive language, however, they found that the children who exhibited more uneven expressive language skills had significantly more stuttering (Walden et al., 2012). In a similar manner, as we widened our lens and looked at the underlying strength of the grammatical system and how that affected disfluencies in general, we observed that grammatical skills significantly predicted disfluencies in one specific group of children: CWS-R.

Thus, the DDS model appears to be a useful framework through which to understand how the maturation of endogenous grammatical skills significantly affects recovery for CWS-R. It is interesting to note that improvements in endogenous linguistic abilities were not sufficient to lead to a reduction in disfluencies for CWS-P. This suggests that further investigation of the impact of the emotional diathesis on disfluency, rather than only the linguistic diathesis, is of interest.

Conclusions and Limitations

The main finding of this study was that CWS-R were significantly less likely to produce a disfluency as grammatical development, not age, progressed. This finding partially corroborates the DDS model. Although these findings are preliminary, we believe that follow-up investigative studies are both promising and warranted. Future studies may find it advantageous to investigate principles of the DDS model using richer and more comprehensive measures of linguistic ability and under more linguistically demanding stations. This line of research would carry both theoretical and clinical implications.

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